CLAIMS

1. Apparatus having a probe for interacting with a surface of a sample, wherein the apparatus comprises:

a Z actuator assembly having first and second extendable and retractable members, wherein the probe is attached to and moved by the first member;

the second member oriented and arranged on the Z actuator assembly with respect to the first member to synchronously move in a direction opposite that of movement of the first member such that a net momentum of the Z actuator is substantially zero upon actuation of the first and second members.

2. The apparatus as defined in claim 1, wherein the first and second members comprise piezo actuators.

3. The apparatus as defined in claim 2, wherein the piezo actuators comprise one of piezoelectric tubes, piezoelectric stacks, and piezoelectric bimorphs.

4. The apparatus as defined in claim 1, wherein the first and second member comprise one of voice coil actuators, electrostatic actuator, electrostrictive actuator, or magnetostrictive actuators.

5. The apparatus as defined in claim 1, further comprising a common central support, the first and second members being supported on opposite sides of the common central support.

6. The apparatus as defined in claim 1, further comprising a probe mount, the probe mount being carried by the first member.

7. The apparatus as defined in claim 6, further comprising a counterbalance, the counterbalance being carried by the second member.

8. The apparatus as defined in claim 7, wherein the probe mount and the first member together have a momentum substantially the same as a momentum of the counterbalance and the second member together.

9. The apparatus as defined in claim 8, wherein a mass of the first member and the probe mount is substantially the same as a mass of the second member and the counterbalance.

10. The apparatus as defined in claim 8, wherein a mass of the first member and the probe mount is not the same as a mass of the second member and the counterbalance.

11. Apparatus for measuring a surface of a sample, the apparatus comprising:

a scanning member having an X actuator, a Y actuator, and a Z actuator; and

opposed first and second members mounted on the Z actuator, each of which is extendable and retractable in the Z direction, wherein the second member is operated to balance a momentum of the first member when the first member is extended and retracted.

12. The apparatus as defined in claim 11, further comprising a probe mount mounted on the first member, the probe mount mounting a cantilever probe.

13. The apparatus as defined in claim 11, wherein the X, Y, and Z actuators comprise one of a scanning tube and a scanning flexure.

14. The apparatus as defined in claim 12, further including a counterbalance mounted on the second member.

15. The apparatus as defined in claim 14, wherein the momentum of the first member and the probe mount together is substantially equal to the momentum of the second member and counterbalance together.

16. The apparatus as defined in claim 14, wherein the mass of the first member and the probe mount together is substantially equal to the mass of the second member and counterbalance together.

17. The apparatus as defined in claim 16, wherein the mass of the first member and the probe mount together is not the same as the mass of the second member and counterbalance together.

18. Apparatus having an actuator for characterizing a surface of a sample with a probe, the actuator being extensible and retractable in a direction either toward or away from the surface, the apparatus comprising:

a common central support carried by the actuator;

a first member carried by the common central support and having a distal end which is extensible and retractable in a direction either toward or away from the surface;

a second member carried by the common central support and having a distal end which is extensible and retractable in a direction either toward or away from the surface, wherein the distal ends of the first and second members substantially synchronously either both extend or both retract.

19. The apparatus as defined in claim 18, wherein the first and second members comprise piezo actuators.

20. The apparatus as defined in claim 19, wherein the piezo actuators comprise one of piezoelectric tubes, piezoelectric stacks, and piezoelectric bimorphs.

21. The apparatus as defined in claim 18, wherein the first and second member comprise one of voice coil actuators, electrostatic actuator, electrostrictive actuator, or magnetostrictive actuators.

22. The apparatus as defined in claim 18, further comprising a mount assembly carried by the distal end of the first member, wherein the mount assembly comprises (i) a probe mount and (ii) a cantilever probe having a fixed end carried by the mount and including a stylus spaced from the fixed end and disposed toward the sample; and further comprising a counterbalance carried by the distal end of the second member.

23. The apparatus as defined in claim 22, wherein a momentum of the first member and the mount assembly together is substantially the same as a momentum of the second member and counterbalance together.

24. The apparatus of claim 22, further comprising a base connected to the actuator, the common central support connected to the base and wherein the common central support is electrically non-conducting, wherein the actuator is hollow and elongated, has an end portion, and includes a plurality of pins extending away from the end portion thereof, and wherein the base defines a corresponding plurality of apertures dimensioned for receiving the pins and operatively connecting the actuator and the base.

25. A method of reducing parasitic oscillations in an apparatus having a fast Z actuator coupled to a slow Z actuator, the fast Z actuator moving a probe which interacts with the surface of a sample, the method comprising the steps of:

balancing a momentum of the fast Z actuator, the momentum being generated when the fast Z actuator moves the probe relative to the surface, with an equal and opposite momentum synchronously generated in the fast Z actuator.

26. The method as defined in claim 25, wherein the equal and opposite momentum is generated by moving a mass equal to the mass of the fast Z actuator at a velocity equal to the velocity of the fast Z actuator.

27. The method as defined in claim 25, wherein the equal and opposite momentum is generated by moving a mass equal to 1/X times the mass of the fast Z actuator at a velocity equal to X times the velocity of the fast Z actuator.